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(54) **Perforating and slitting die sheet, methods of constructing same and paper product produced therefrom**

Stanzblech sowie Verfahren zur Herstellung desselben und daraus hergestelltes Papierprodukt

Outil d'estampage ainsi que méthodes pour la fabrication de celui-ci et produit en papier obtenu avec cet outil

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Description

[0001] The present invention relates to die sheets for cutting dies, methods of constructing such die sheets and products produced therefrom, and more particularly, to a die sheet or roll for a cutting die for producing curvilinear patterns of perforations adjacent to patterns of continuous slits.

Background of the Invention

[0002] Cutting dies, in particular rotary cutting dies for cutting paper products, are well known. Cutting dies are used for cutting shapes in paper, plastic film and thin metal foil. In particular, they are used in the printing and packaging industries for cutting perforations and openings in pressure sensitive labels.

[0003] Pressure sensitive labels, markers, and other similar articles formed by cutting dies are usually made available in strips or rolls. A plurality of such labels or the like are attached to an elongated backing layer by a pressure sensitive adhesive or gum. The pressure sensitive adhesive or gum is permanently adhered to the back of the label while the backing layer is provided with a release coating. Hence, a label having pressure sensitive adhesive separates readily from the backing layer or release layer. The user merely peels the labels or markers from the backing layer and applies the peeled-off labels or markers as required.

[0004] In order to mass produce these labels or markers, a strip comprising a layer of label material, a layer of pressure sensitive adhesive and a backing layer are assembled and passed under the cutting die. The cutting die may have any convenient arrangement or array of patterns thereon in accordance with the shapes desired for the labels. The labels are formed by cutting through the layer of label material adhered to the backing layer and through the adhesive layer beneath the layer of label material. Often, the dimensions of the cutting edge, as well as the tolerance of the dimensions, are selected to prevent the die from cutting through the backing layer. In this manner a continuous strip or sheet of labels is maintained.

[0005] From GB-A 1,240,167 it is known a sheet of pressure sensitive labels adapted for use in a machine that is computer operated. The sheet of labels is comprised of a backing layer and a label layer. The label layer is affixed to the backing layer with a coating of pressure sensitive adhesive, which adheres to the label layer and peels away from the backing layer. The label layer is divided into longitudinal rows and transverse rows. Each label layer is comprised of a plurality of labels. The label layers are at least partially severed along both the transverse rows and the longitudinal rows. The backing layer is partially severed only along the transverse row. In use, the labels are applied to goods by attaching a portion of a label to a good and pressing the upper face of the label with a finger. As the label is se-

cured to the good a second label is partially exposed from the backing and the transverse row of backing remains in a single strip. So, this patent discloses a backing sheet divided into a plurality of transverse rows and a label sheet divided along the same transverse rows as well as along longitudinal rows.

[0006] Furthermore, it is known to form a flexible die or die roll by a chemical etching process. The chemical etching of the flexible dies is performed primarily by the use of a photofabrication technique. In this photofabrication technique the metal forming the die is first coated on its front side with a light sensitive "photo-resist". The photosensitive resist is exposed to ultraviolet rays through a photographic transparency containing a clear image of the features of the die cutting pattern. Flexible cutting dies formed by this type of chemical photoetching process are either secured magnetically to magnetic cylinders or rollers or to non-magnetic cylinders using an adhesive layer between the die and the non-magnetic cylinder.

[0007] From EP-A 702 269 it is known a method for forming a cutting die using a multiple etching process. After photo-resist layers have been formed on the die, a first etching process occurs. After the first etching process, the resist patterns for the lower cutting edges are removed and a second etching process is performed. Then the remaining photo-resist patterns are removed and final etching is performed to form the higher cutting edges and the lower cutting edges. Alternatively, instead of removing just parts of the photo-resist layers it is also possible to remove all of the resist patterns and to perform a sealing treatment on the high cutting edges. Then, the second etching process is performed, the sealing is removed from the high cutting edges, and a finishing etching process is formed to generate the high cutting edges and the low cutting edges.

[0008] By way of this method it is possible to produce a cutting die having low cutting edges and high cutting edges which can be used for simultaneously cutting a paper product at two different levels, so that a double layer paper product can be cut by way of the higher cutting edges while the lower cutting edges can be used to just cut the upper layer of the paper product leaving the lower layer uncut.

[0009] One particular use for the cutting dies described above is for the postage stamp industry, specifically for the production of "peel-away" stamps which have an adhesive layer that enables the stamp to be peeled from a backing sheet and placed on an envelope or other surface without having to wet the back of the stamp. Generally, the peel-away stamps that are produced by known methods have the serpentine edges which are familiar to the old style gummed-back stamps. However, sheets of peel-away stamps as currently produced have a solid backing sheet which does not allow a backing section for an individual stamp to be easily detachable from the remainder of the backing sheet when detaching a single stamp.

[0010] In an attempt to overcome the inability of peel-away stamps to have an individually detachable backing, a die sheet was developed to produce sheets of postage stamps which have a stamp sheet with continuous openings and a backing sheet with spaced openings aligned with the openings of the stamp sheet. These die sheets are referred to as a "perf-over-slit" die sheets and they have two cutting levels: a lower slitting level having continuously joined cutting members and an upper perforating level which has spaced cutting members. With such a die sheet, a pattern of straight lines of spaced openings can be produced in a first sheet of a material and a pattern of straight continuous openings can be produced in a second sheet of material which is in facing relationship with the first sheet of material. Postage stamps have been produced by such dies, but such postage stamps have not been accepted by collectors who have rejected the straight-edged stamps for not being as aesthetically pleasing as classical serpentine-edged stamps.

[0011] The utility of perf-over-slit die sheets has been limited to producing patterns of straight cuts in materials because it has been too difficult and too costly to attempt to construct a perf-over-slit die sheet with cutting edges that produce curved openings using conventional methods. Attempts have been made to produce perf-over-slit die sheets by forming a cutting surface extending above a die sheet by a chemical etching process and then machining away sections of the material to produce a lower cutting level (the slitting level) at sections where the material has been machined away and an upper cutting level (the perforating level) at sections where no machining occurred.

[0012] As these die sheets have relatively short cutting levels and closely packed die patterns, it has been extremely difficult to attempt to produce perforating sections on a curved cutting pattern due to the large number of direction changes required during the milling or grinding of a curved die pattern. Attempts at producing a die sheet having a curvilinear "perf-over-slit" die pattern using conventional machining methods have been unsuccessful.

[0013] Therefore, there is a need for a paper product, particularly for the postage stamp industry, which has a pattern of continuous, serpentine-shaped openings in a first sheet of material (the sheet of stamps) and a pattern of spaced, curvilinear openings in a second sheet of material (the backing sheet) which are aligned with the openings of the first sheet. Such a paper product will have an appearance which appeals to stamp collectors and will enable the individual stamps to be separable from the remainder of the sheet along with an individual section of the backing material. Thus, there is also the need a die sheet to form such a product and a method or methods for producing such a die sheet.

Summary of the Invention

[0014] In a first aspect, the present invention is a paper product having a first sheet which has a pattern of one or more lines of spaced openings extending at least partially through it a distance sufficient to permit the sheet to be readily separable into one or more sections. The one or more lines of spaced openings divides the first sheet into a plurality of sections. The paper product further includes a second sheet which is releasably attached in facing engagement to the first sheet and has a pattern of continuous curvilinear openings extending through it. The pattern of continuous curvilinear openings divides the second sheet into a corresponding plurality of sections and are aligned with the pattern of spaced openings of the first sheet.

[0015] In a second aspect, the present invention is directed to a flexible die sheet according to claim 9.

[0016] In a third aspect, the present invention is directed to a first method of constructing a die sheet for cutting material which includes the steps set out in claim 10.

[0017] In a fourth aspect, the present invention is a second method of constructing a die sheet for cutting material which includes the steps set out in claim 13.

Brief Description of the Drawings

[0018] The foregoing summary, as well as the following detailed description of preferred embodiments of the invention, will be better understood when read in conjunction with the appended drawings. For the purpose of illustrating the invention, there is shown in the drawings, which are diagrammatic, embodiments which are presently preferred. It should be understood, however, that the invention is not limited to the precise arrangements and instrumentalities shown. In the drawings:

Fig. 1 is an enlarged partial bottom plan view of a paper product according to the present invention;
Fig. 2 is an enlarged partial top plan view of a paper product according to the present invention;

Fig. 3 is an enlarged cross-sectional view of the paper product of the present invention taken along lines 3-3 of Fig. 2;

Fig. 4 is a perspective view of a die assembly in the process of forming a paper product in accordance with the present invention;

Fig. 5 is a greatly enlarged fragmentary view of a portion of a die sheet which forms a portion of the die assembly of Fig. 1;

Fig. 6 is a greatly enlarged fragmentary view of the die sheet of Fig. 5;

Fig. 7 is an enlarged cross-sectional view of the die sheet shown in Fig. 6 taken along 7-7 of Fig. 6;

Fig. 8 is an enlarged cross-sectional view of the die sheet shown in Fig. 6 taken along lines 8-8 of Fig. 7;

Fig. 9 is a greatly enlarged cross-sectional view of

the die assembly shown in Fig. 4 taken along lines 9-9 of Fig. 4, illustrating the cutting action of a die sheet assembled in a cutting die;

Fig. 10 is a perspective view of a solid cylindrical die in accordance with a second embodiment of the present invention;

Fig. 11 is an enlarged partial top plan view of a first pattern of a first photo-resist material according to a first preferred method of the present invention, shown on a die sheet surface;

Fig. 12 is an enlarged partial top plan view of a second pattern of a second photo-resist material according to the first preferred method of the present invention, shown on the die sheet surface of Fig. 11;

Fig. 13 is a greatly enlarged fragmentary view of the die sheet surface of Fig. 12, illustrating the overlapping nature of the first and second patterns; and

Fig. 14 is an enlarged partial top plan view of a pattern of a photo-resist material according to a second preferred method of the present invention, shown on a die sheet surface.

Detailed Description of Preferred Embodiments

[0019] Certain terminology is used in the following description for convenience only and is not limiting. The words "upper" and "lower" refer to a greater height and a lesser height, respectively, above a die sheet surface. The terminology includes the words above specifically mentioned, derivatives thereof and words of similar import.

[0020] Referring now to the drawings in detail, wherein like numerals are used to indicate like elements throughout, there is shown in Figs. 1-3 a preferred embodiment a paper product 80 including a first sheet 16 and a second sheet 18 in facing relationship. Referring to Figs. 1 and 3, the first sheet 16 has a pattern 37 of one or more lines 84 of spaced openings 36 extending at least partially therethrough a distance sufficient to permit the first sheet 16 to be readily separable into one or more sections 86. Preferably, each of the lines 84 of spaced openings or perforations 36 extending through the first sheet 16 is serpentine-shaped, as shown in Fig. 1, and extends completely through the first sheet 16, as shown in Fig. 3.

[0021] The pattern 37 of lines 84 of spaced openings 36 divides the first sheet 16 into a plurality of backing sections 86. Each backing section 86 of the first sheet 16 is detachable from the remainder of the first sheet 16 by tearing the first sheet 16 along the one or more lines 84 of the pattern 37 of spaced openings 36.

[0022] Referring to Figs. 2 and 3, the second sheet 18 is releasably attached in facing engagement to the first sheet 16 and has a pattern 33 of continuous curvilinear openings 32 extending therethrough. The pattern 33 of continuous curvilinear openings 32 divides the second sheet 18 into a plurality of label sections 88, each corresponding to one aligned section 86 of the first

sheet 16, and is aligned with the pattern 37 of spaced openings 36 of the first sheet 16. Preferably, each of the continuous curvilinear openings 32 extending through the second sheet 18 is serpentine-shaped, as shown in Fig. 2.

[0023] Referring to Fig. 2, the pattern 33 of continuous curvilinear openings 32 extending through the second sheet 18 form at least one quadrilateral 90, and preferably a plurality of quadrilaterals 90, which each bound one label section 88 of the second sheet 18. Each label section 88 of the second sheet 18 includes an adhesive material 92 attached to an inward-facing surface 89 of the second sheet 18, as shown in Fig. 3. The adhesive material 92 releasably attaches each of the label sections 88 of the second sheet 18 to the first sheet 16. The adhesive material 92 remains attached to the inward-facing surface 89 upon removal of one of the label sections 88 of the second sheet 18 from the first sheet 16 to enable attachment of the removed label section 88 of the second sheet 18 to another surface, such as, for example, the front of a paper envelope (not shown). The aligned backing and label sections of the first sheet 16 and the second sheet 18 are removable from a remainder of the first and second sheets 16 and 18 as a single unit (not shown). This is accomplished by tearing along one or more lines 84 of spaced openings 36 of the first sheet 16 while the label sections 88 of the second sheet 18 are still attached by the adhesive material 92 to the corresponding backing sections 86 of the first sheet 16.

[0024] Furthermore, each of the label sections 88 of the second sheet 18 are detachable from the remainder of the label sections 88 of the second sheet 18 and from the first sheet 16. Separation of each label section 88 is accomplished by peeling the label section 88 from the backing section 86 of the first sheet 16 with which it is aligned so that the adhesive layer 92 backing the inward facing surface 89 of the label section 88 becomes detached from the corresponding backing section 86 of the first sheet 16.

[0025] Preferably, the first sheet 16 and the second sheet 18 are different materials. Most preferably, the second sheet 18 is a thin paper of a weight and type usually used to construct U.S. postage stamps with a releasable glue-backing well understood by those of ordinary skill in the art. The first sheet 16 is preferably relatively stiff paper such as a thin paperboard/heavy weight paper to provide the paper product 80 with self-support. However, it is within the scope of the present invention to form the paper product 80 so that the first sheet 16 and the second sheet 18 are the same material 14 and to produce the paper product 80 from any other combination of materials appropriate for the intended application of the product 80.

[0026] In the preferred embodiment, the backing and label section 86, 88 are preferably U.S. postage stamp size. However, it is understood by those of ordinary skill in the art from this disclosure that the present invention is not limited to any particular size backing or label sec-

tions 86, 88.

[0027] Referring to Figs. 4-10, the present invention further includes a die sheet 10 for a die 12 for cutting a material 14 having a first sheet 16 and a second sheet 18 in facing relationship and preferably for forming a paper product 80 as described above. The die sheet 10 is comprised of a die sheet surface 20 having a die pattern 22 extending outwardly from the die sheet surface 20 to form a cutting surface 24 of the die sheet 10. The die pattern 22 has at least one slitting section 26 and a plurality of spaced perforating sections 28, each type of section being described in detail below.

[0028] Referring now to Figs. 1-4 and 6-8, each slitting section 26 has at least one cutting edge 30 configured for providing a curvilinear, continuous opening 32 through the second sheet 18 of the material 14. A slitting section 26 is constructed of two types of segments, as best shown in Fig. 7. The two types of segments are slitting segments 27, which perform slitting alone, and perf-over-slit segments 29, which include the perforating segments 28 and perform both slitting of the second sheet 18 and perforation of the first sheet 16. Both the slitting segments 27 and the perf-over-slit segments 29 of a slitting section 26 are required to provide a continuous curvilinear opening 32 in a second sheet 18 of a material 14. In other words, the cutting edge 30 of a slitting section 26 consists of cutting edge sections 31 of the slitting segments 27 and cutting edge sections 33 of the perf-over-slit segments 29, which are the cutting edges of the perforating sections 28 as described below.

[0029] The cutting edge sections 31 of the slitting segments 27 are preferably single-edged, as best shown in Figs. 6, 8 and 9. However, it is within the scope of the present invention to construct the slitting segments 27 so that the cutting edge sections 31 are double-edged (not shown).

[0030] Referring to Figs. 4-7, preferably, the cutting edges 30 of all of the slitting sections 26 combined are configured for providing a serpentine-shaped opening 32 through the second sheet 18 of material 14, the opening 32 being as shown in Figs. 2 and 4. However, it is within the scope of the present invention to construct the slitting sections 26 so that the opening 32 has other curvilinear shapes, such as, for example, a single arcuate curve (not shown) or a complex curve (not shown). The present invention is intended to embrace all slitting sections 26 which, when combined, are configured to provide an opening 32 in the second material 18 having any shape other than a straight line.

[0031] Furthermore, as shown in Figs. 2, 4 and 5, the die pattern 22 preferably includes a plurality of slitting sections 26 configured to provide a pattern 33 of continuous curvilinear openings 32 in the paper product 80. Preferably, the plurality of slitting sections 26 are arranged so that the die pattern 22 includes at least one quadrilateral 35, and most preferably a plurality of quadrilaterals 35, formed by the arrangement of the slitting sections 26, as shown in Figs. 4 and 5.

[0032] Referring again to Figs. 4-10, the plurality of spaced perforating sections 28 extend outwardly from the slitting sections 26. More specifically, each perforating section 28 extends outwardly from one of the perf-over-slit segments 29, such that the perforating section 28 is the upper portion of the perf-over-slit segment 29. The plurality of perforating sections 28 are configured for providing a pattern 37 of spaced openings 36 in the first sheet 16 adjacent to the curvilinear openings 32 through the second sheet 16, the openings in the two sheets being arranged as shown in Figs. 1-3.

[0033] Each of the perforating sections 28 has at least one cutting edge 34 and is configured for extending at least partially through the first sheet 16 of the material 14. The cutting edge 34 is also the cutting edge section 33 of a perf-over-slit segment 29 of the slitting section 26 so that the cutting edge 34 is both a separate cutting edge and a section of the cutting edge 30. The dual designation of the cutting edge is necessary due to each perforating section 28 being intended to function by extending completely through the second sheet 18 of the material 14 to form a portion of a continuous opening 32 and also by extending at least partially through the first sheet 16 to form one opening 36 in the pattern 37 of spaced openings 36.

[0034] Preferably, as shown in Figs. 5 and 6, each perforating section 28 is constructed having an arcuate shape, and most preferably, a substantially semi-circular shape. However, it is within the scope of the present invention to construct the perforating sections 28 to have any other appropriate shape, such as, for example, circles or quadrilaterals.

[0035] In the preferred embodiment of a die sheet 10 for forming the paper product 80 of the present invention wherein the paper product 80 is comprised of 50 pound first and second sheets 16, 18, the cutting edges 31 of the slitting segments 27 of the slitting sections 26 preferably extend from about 0.010 to about 0.012, and most preferably about 0.011, above the remainder of the die sheet surface 20. Furthermore, the cutting edges 34 of the perforating sections 28 preferably extend from about 0.0135 to about 0.014, and most preferably about 0.014, above the remainder of the die sheet surface 20. These dimensions will vary depending upon the paper thickness.

[0036] Preferably, the die sheet 10 is constructed of a metal such as hardened high carbon steel or hardened stainless steel by one of the methods described in detail below. However, it is within the scope of the present invention to construct the die sheet 10 from any other appropriate material, such as tool steel, and to construct the die sheet 10 by any other process which is capable of producing the die sheet 10 as described above.

[0037] Referring to Figs. 4 and 9, the present invention includes a die assembly 40 for cutting a material 14 having a first sheet 16 and a second sheet 18 in facing relationship. The die assembly 40 is comprised of a die sheet 10, as described in detail above, a pressure sur-

face 42 in engagement with the die sheet 10 for applying the die sheet 10 to the material 14 and an adhesive 44 securing the die sheet 10 to the pressure surface 42. Preferably, the pressure surface 42 is the outer surface 46 of a cylindrical die roll or platen 48 mounted to a shaft 47 which enables rotation of the platen 48. The pressure surface 42 applies cutting force to the die sheet 10 to cut the material 14 pressed between the die sheet 10 and a hard roll 49. The platen 48 and the hard roll 49 are mounted within a conventional cutting press (not shown), which is well known to one skilled in the relevant art and need not be described further herein. The adhesive 44 is preferably an epoxy resinous material, however, it is within the scope of the present invention to utilize any other appropriate adhesive material for adhesive 44. The die sheet 10 can also be mounted onto a magnetic cylinder, as is well understood by those of ordinary skill in the art.

[0038] Referring to Fig. 10, in the second embodiment, the present invention further includes a die 55, having a die surface 21, for cutting the material 14 having a first sheet 16 and a second sheet 18 in facing relationship. The elements of the die surface 21 of the die 55 are similar to the elements of the die sheet surface 20 of the die sheet 10 and, therefore, reference is made to Figs. 5-8. The die 55 is comprised of a die surface 21 having a die pattern 22 extending outwardly from the die surface 20 to form a cutting surface 24 of the die 54. The die pattern 22 has at least one slitting section 26 having at least one cutting edge 30 configured for providing a curvilinear, continuous opening 32 through the second sheet 18 of the material 14. Furthermore, the die pattern 22 has a plurality of spaced perforating sections 28 extending outwardly from the slitting sections 26. Each of the perforating sections 28 has at least one cutting edge 34 and is configured for extending at least partially through the first sheet 16 of the material 14. The plurality of perforating sections 28 are configured for providing a pattern of spaced openings 36 in the first sheet 16 adjacent to the curvilinear opening 32 through the second sheet 18.

[0039] Preferably, as shown in Fig. 10, the die 55 is constructed as a cylinder which is capable of being rotationally mounted in a conventional cutting press (not shown). However, it is within the scope of the present invention to construct the die 55 as a rectangular solid (not shown) which would be utilized in a cutting press (not shown) capable of producing reciprocating linear movement of the die.

[0040] Referring to Figs. 11-13, the present invention includes a first preferred method for constructing a die sheet 10 for cutting the material 14, and preferably for forming the paper product 80 described above, comprised of the following steps. The die sheet 10 constructed by the first preferred method includes all the elements described above in the detailed description of the die sheet 10. In the method outlined below, the die sheet 10 is preferably constructed from a thin rectangular

block or a cylindrical block of a metal, such as hardened high carbon steel or hardened stainless steel, and preferably tool steel.

[0041] First, as shown in Fig. 11, a plurality of spaced sections 50 of a die sheet surface 20 of the die sheet 10 are covered with a first photo-resist material 52 to form a first pattern 54 of a first width W_1 . The first width W_1 varies, depending upon paper thickness, the press used and the die configuration. The plurality of sections 50 are disposed on the die sheet surface 20 so that the first pattern 54 is generally curvilinear. Preferably, each of the spaced sections 50 has an arcuate shape which is substantially half-elliptical, as shown in Fig. 8. However, it is within the scope of the present invention to cover spaced sections 50 which have any other appropriate shape.

[0042] Preferably, the first pattern 54 of the first photo-resist material 52 is comprised of a plurality of covered spaced sections 50 of the die sheet surface 20 which are disposed as a plurality of curvilinear dashed lines 57 and which intersect in a substantially perpendicular manner. Further preferably, the dashed lines 57 of the first pattern 54 intersect to form a cross-shaped portion 61 which has an arcuate section extending from each end, as shown in Fig. 11.

[0043] As photo-resist materials are known, it is unnecessary to discuss in detail the reasons for selecting a particular first photo-resist material 52. However, it is preferred to use negative photo-resist for the first photo-resist material 52, which are resistant to inorganic solvents but not resistant to organic solvents, the purpose for this resistance criteria being discussed below. It will be appreciated by those skilled in the art that other materials may be utilized for the first photo-resist material 52 and the present invention is intended to embrace these alternative materials.

[0044] Furthermore, as techniques for applying photo-resist patterns are also well known to those skilled in the relevant art, detailed discussion of the actual processes for applying the first pattern 54 is also unnecessary. It is preferred, however, to cover at least a portion of the die sheet surface 20 with the photo-resist material 52, and then place a pattern negative (not shown) onto the covered die sheet surface 20 and project ultraviolet light onto the top of the pattern negative to transfer the desired first pattern 54 to the first photo-resist material 52. Photo-resist material that is exposed to the ultraviolet light adheres to the die sheet surface 20 and the material in areas not radiated with ultraviolet light, the areas covered by the pattern negative, would then be washed from the die surface 20 with an appropriate developing solution, such as xylene.

[0045] Referring now to Fig. 12, next, at least one continuous section 56 of the die sheet surface 20 is covered with a second photo-resist material 57 to form a second pattern 58 of a second width W_2 . The second width W_2 varies, depending upon paper thickness, the press used and the die configuration. The second pattern 58 covers

the first pattern 54 and is curvilinear. As the second width W_2 of the second pattern 58 is greater than the first width W_1 of the first pattern 54, the sides 59 of the second pattern 58 extend beyond the sides 53 of the first pattern 54, as shown in Fig. 13.

[0046] Preferably, a plurality of continuous sections 56 of the die sheet surface 20 are covered by the second pattern 58 of the second photo-resist material 57, as is shown in Fig. 12, which preferably intersect in a substantially perpendicular manner to form a plurality of quadrilaterals (not shown). Further preferably, the plurality of continuous sections 56 intersect to form a cross-shaped section 63, as shown in Fig. 12.

[0047] Referring now to Figs. 12 and 13, it is further preferred that the second pattern 58 includes a plurality of reinforcing segments 60 of a third width W_3 . Each of the reinforcing segments 60 is disposed proximal to a longitudinal end 51 of each of the spaced sections 50 of the die sheet surface 20 covered by the first pattern 54. The third width W_3 is greater than the second width W_2 , so that the reinforcing segments 60 extend from both of the sides 59 of the second pattern 58. Preferably, each of the reinforcing segments 60 is shaped substantially as a quadrilateral, as shown in Figs. 12 and 13, although it is within the scope of the present invention to form the reinforcing segments 60 as another appropriate shape, such as, for example, elliptical. The purpose of these reinforcing segments 60 is discussed in detail below.

[0048] Preferably, the second photo-resist material 57 is aqueous photo-resist, which is not resistant to inorganic solvents as are the preferred materials for the first photo-resist material 52. However, it will be appreciated by those skilled in the art from this disclosure that other materials may be utilized for the second photo-resist material 57 and the present invention is intended to embrace these alternative materials. The second pattern 58 is preferably applied to the die sheet surface 20 in the same manner as the first pattern 54, but may be accomplished by any other method known to those skilled in the relevant art.

[0049] Next, die material is removed from the sections 62 of the die sheet 10 not covered by the second pattern 58 by applying a chemical (not shown) to the die sheet surface 20 of said die sheet 10. As chemical etching is well known to those skilled in the relevant art, detailed explanation of the mechanics of the material removal process of the present method is unnecessary. The chemical removes die material from the die sheet surface 20 at the non-covered sections 62 to a desired depth, which results in the sections 56 covered by the second pattern 58 extending above the remainder of the die sheet surface 20 by an amount equal to the depth of the die material removed.

[0050] In the preferred application of the first method for constructing a die sheet 10 for forming the paper product 80 of the present invention wherein the first and second sheets 16, 18 are 50-pound paper, die material is removed from the non-covered sections 62 of the die

sheet surface 20 to a depth of from about 0.013 to about 0.014, and most preferably about 0.013. Thus, the majority of the die material under the second pattern 58 of the second photo-resist material 57 extends above the remainder of the die sheet surface 20 by an equivalent amount.

[0051] Furthermore, some die material will be removed from the sections 56 covered by the second pattern 58 by a process referred to as "undercutting". Undercutting of the pattern occurs due to the die material under the photo-resist material being exposed to the chemical after the removal of adjacent, non-covered die material. Undercutting begins at the sides 59 of the second pattern 58 and progresses inwardly toward the centerline 57 of the second pattern 58. The result is that the centerline 57 extends the greatest height above the die sheet surface 20 and there is a boundary section (not shown) where the height of the covered die material tapers down to blend with the remainder of the die sheet surface 20.

[0052] The chemical is selected from any known chemical used in metal etching, such as, for example, nitric acid, ferric chloride, hydrochloric acid, and is most preferably ferric chloride. Preferably, the selected chemical is applied to the die sheet surface 20 by continuously spraying the chemical from nozzles (not shown), which are attached to manifold pipes, that oscillate at a high speed across the die sheet surface 20 of the die sheet 10. However, it is well within the capabilities of one skilled in the relevant art to select a suitable chemical and a suitable application technique, such as dipping, to accomplish the removal of material from the uncovered sections of the die surface 20. The present invention is intended to embrace all known alternative processes which accomplish the removal of material from the uncovered sections of the die surface 20 by applying a chemical.

[0053] Then, the second photo-resist material 57 of the second pattern 58 is removed from the die sheet 10 by applying a solvent (not shown) to the die sheet surface 20 of the die sheet 10. Removal of a photo-resist material with a solvent is generally known to those skilled in the relevant art so it is unnecessary to discuss in detail herein such matters as the mechanics of the action of a solvent or techniques for applying such solvents. Preferably, the solvent is potassium hydroxide, which is an inorganic solvent. The first photo-resist material 52 of the first pattern 54 is selected to be non-reactive with the solvent, so that the first pattern 54 remains on the die sheet after application of the solvent to the die sheet surface 20. However, it is well within the capabilities of one skilled in the relevant art to select a suitable first photo-resist material 52, a second photo-resist material 57, and a solvent (not shown) so that the second pattern 58 is removed without removing or affecting the first pattern 54.

[0054] Finally, die material is removed from sections 62 of the die sheet 10 not covered by the first pattern 54

by applying a chemical (not shown) to the die sheet surface 20 of the die sheet 10. As with the first die material removal step described above, the removal of die material may be accomplished by known chemical or electrolytic techniques.

[0055] During this second die material removal step, die material will be primarily removed from two sections of the die surface 22. Material is removed from sections of the die surface 22 which were not covered by the second pattern 58 of the second photo-resist material 57 and from which material was removed during the first die material removal step, which further increases the depth of removed die material. Also, die material is removed from the sections of the die sheet surface 20 which extended above the remainder of the die surface 20 after the first material removal step and which became uncovered after removal of the second pattern 58 of the second photo-resist material 57.

[0056] Thus, after the second die material removal step, there will be two levels of the die pattern 22 extending above the remainder of the die sheet surface 20. First, an upper level of perforating sections 28 at the sections of the die surface 20 covered by the first pattern 54 of the first photo-resist material 52. Second, a lower level of the slitting segments 27 of the slitting sections 26 at the sections of the die surface 20 which were covered only by the second pattern 58 of the second photo-resist material 57.

[0057] Furthermore, as discussed above in the first die material removal step, undercutting of the first pattern 54 will also occur. Preferably, the first pattern 54 of the first photo-resist 52 is almost completely undercut so that the finished perforating sections 28 have single-edged cutting edges 34. The reinforcing segments 60 of the second pattern 58 enable additional die material to remain after the first die material removal step in the areas of the die sheet surface 20 near the longitudinal ends 51 of the sections 50 covered by the first pattern 54. This additional die material counteracts the tendency of the chemical to excessively undercut the longitudinal ends 51 of the sections 50 covered by the first pattern 54 during this second die material removal step. This excessive undercutting would ordinarily occur due to the simultaneous undercutting of the ends 51 and the sides 53 of each section 50 covered by the first pattern 54 and would cause the finished perforating sections 28 to be shorter than desired.

[0058] In the preferred application of the first method for constructing a die sheet 10 for forming the paper product 80 of the present invention, after the second die material removal step, the cutting edges 34 of the perforating sections 28 and the cutting edges 31 of the slitting segments 27 extend above the remainder of the die sheet surface 20 at approximately the preferred dimensions for the die sheet 10 as discussed above.

[0059] Preferably, a solvent (not shown) is applied to the die sheet surface 20 to remove the first pattern 54 after the second material removal step. At this point in

the method, a die sheet 10 has been constructed which is capable of producing the paper product 80 discussed in detail above. However, it is preferred to further shape the cutting edges sections 31 of the slitting segments 27 of the slitting sections 26 and the cutting edges 34 of the perforating sections 28 (which are also the cutting edge sections 33 of the cutting edges 30 of the slitting sections 26 as discussed above). Final shaping of these cutting edges is accomplished by applying a chemical to hone the edges. Such chemical honing is well known, so it is unnecessary to discuss the process in detail herein. Although it is preferred to utilize ferric chloride to accomplish this chemical honing, any suitable chemical that can be applied to hone the cutting edges is embraced within the scope of the present invention.

[0060] Referring to Fig. 14, the present invention further includes a second preferred method for constructing a die sheet 10 for cutting a material 14, and preferably for forming the paper product 80. The second method is essentially a two step process, as compared to the multi-step process of the first preferred method. However, both processes result in the construction of a die sheet 10 having all of the elements discussed in detail above in the description of the die sheet 10. In the method outlined below, the die sheet 10 is preferably constructed from the same preferred materials discussed above in the description of the first method.

[0061] Referring again to Fig. 14, first, at least one continuous curvilinear section 64 of a die sheet surface 20 of the die sheet 10 is covered with a photo-resist material 66 to form a pattern 68 of alternating slitting segments 70 of a first width W_1 and perforating segments 72 of a second width W_2 . In the pattern 68, the second width W_2 is greater than the first width W_1 . Each of the perforating segments 72 extends from a side of the pattern 68 opposite a side of the pattern 68 from which another most proximal perforating segment 72 extends. In other words, the perforating segments 72 alternately extend from opposite sides of the pattern 68, as is shown in Fig. 14.

[0062] Preferably, the pattern 68 of the photo-resist material 66 is comprised of a plurality of curvilinear lines 69 of continuous curvilinear sections 64 of the die sheet surface 20 which intersect in a substantially perpendicular manner. Further preferably, the lines 69 of the pattern 68 intersect to form a cross-shaped section 71 which is joined at each end of the cross to a perforating segment 72, as shown in Fig. 14.

[0063] Second, die material is removed from the die sheet surface 20 of the die sheet 10 by applying a chemical (not shown) to the die sheet surface 20 to form a cutting surface 24 extending above the remainder of the die sheet surface 20. The photo-resist material 66 is resistant to the chemical, so the removal of die material beneath the pattern 68 is impeded by the photo-resist material 66. The die material below the pattern 68 is removed only after the removal of adjacent uncovered die material. The covered die material is removed by the

applied chemical undercutting the pattern 68, as discussed with the first method.

[0064] Once again, as chemical etching is well known to those skilled in the relevant art, detailed explanation of the material removal process of the present method is unnecessary. The chemicals and application technique described as preferred in the above disclosure of the first method are also preferred for the second method.

[0065] During the step of removing die material from the die surface 20 of the die sheet 10, the timing is such that the chemical almost completely undercuts the slitting segments 70 to form a slitting section 26 of the cutting surface 24 and at least partially undercuts the perforating segments 72 to form a perforating section 28 of the cutting surface 24. The perforating sections 28 have a greater height than the slitting sections 26. The difference in height between the slitting sections 26 and the perforating sections 28 results from the greater width of the perforating segments 72 of the photo-resist pattern 68 as compared with the width of the slitting segments 70 of the pattern. By applying a sufficient amount of a chemical for a sufficient period of time so that a first width of a resist pattern is completely undercut when there is a second, greater width of the pattern will result in two levels extending above the remainder of the surface of the material to which the chemical is applied.

[0066] In the die material removal step, the depth of the material removed from the die sheet surface 20 dictates both the height of the slitting sections 26 and the perforating sections 28 and the relative height differential between the slitting sections 26 and the perforating sections 28 on the finished die sheet 10. Material is removed from the die sheet surface 20 essentially uniformly from the non-covered sections due to the application of the chemical over the entire die sheet surface 20. The effect of undercutting will cause die material to be removed up to the centerline 73 at the slitting segments 70 before the undercutting reaches the centerline 73 at the perforating segments 72. Die material is then removed from the top of the slitting segments 27 of slitting sections 26 while the top of the perforating sections 28 (the perf-over-slit segments 29 of the slitting section 26) are still at the original height above the bottom surface (not shown) of the die sheet 10, or in other words, at the original thickness of the die sheet 10. This will cause a height differential to exist between the top of the slitting segments 27 of the slitting sections 26 and the top of the perforating sections 28 of the die sheet 10.

[0067] The height differential discussed above can be varied by adjusting the difference between the width W_1 of the slitting segments 70 of the pattern 68 and the width W_2 of the perforating segments of the pattern 68. Furthermore, the height of both sections can be varied by varying the widths of each type of segments of the pattern 68. In other words, the wider the two types of segments of the pattern 68 are made, the higher the perforating sections 28 and slitting segments 27 will extend

above the remainder of a finished die sheet 10 and the wider both sections will.

[0068] Preferably, the chemical almost completely undercuts the perforating segments 72 of the pattern 68 a sufficient distance so that the perforating sections 28 include a single cutting edge 34, as shown in Figs. 3-5 for the die sheet 10. However, it is within the scope of the present invention to control the etching process so that the chemical only partially undercuts the perforating segments 72, resulting in the perforating sections 28 on the die sheet 10 which include a double cutting edge (not shown).

[0069] In the preferred application of the second method for constructing a die sheet 10 for forming the paper product 80 of the present invention, after the die material removal step, the cutting edges 34 of the perforating sections 28 and the cutting edges 31 of the slitting segments 27 extend above the remainder of the die sheet surface 20 at approximately the preferred dimensions for the die sheet 10 as discussed above.

[0070] At this point of the method, a die sheet 10 has been constructed which is capable of producing the paper product 80 discussed in detail above. However, as with the first preferred method, it is preferred to further shape the cutting edges sections 31 of the slitting segments 27 of the slitting sections 26 and the cutting edges 34 of the perforating sections 28 by chemical honing.

[0071] There are a number of advantages of the present invention in its various aspects. The die sheet 10 is advantageous over prior art "perf-over-slit" die sheets because it can produce curvilinear openings in a material, as opposed to being limited to producing straight-lined openings as were prior art dies. Both methods of constructing the die sheet 10 have the advantage over the prior art method of combined etching and machining in that they are much simpler to perform and have much greater rate of success than the prior art method. Furthermore, the paper product 80 of the present invention has the advantage, when the product is a peel-away postage stamp, of the sections 88 of the second sheet 18 (i.e. a stamp) having curvilinear edges, which are more appealing to a stamp collector than straight edged stamps. Also, the individual label sections 88 of the second sheet 18 can be removed from the remainder of the second sheet 18 along with the corresponding backing section 86 of the first sheet 16. In other words, an individual peel-away stamp, one label section 88 of the second sheet 18, can be removed from a sheet of such stamps along with its backing paper, the corresponding backing section 86 of the first sheet 16. This is not possible with prior art peel-away stamps available from the United States Postal Service which do not contain perforated backing sheets.

[0072] It will be appreciated by those skilled in the art that changes could be made to the embodiments described above without departing from the broad inventive concept thereof. It is understood, therefore, that this invention is not limited to the particular embodiments

disclosed, but it is intended to cover modifications within the scope of the present invention as defined by the appended claims.

Claims

1. A paper product (80) comprised of:

a first sheet (16) having a pattern (37) of at least two lines (84) of spaced openings (36) extending in the longitudinal and transverse directions thereof at least partially therethrough a distance sufficient to permit said sheet (16) to be readily separable into one or more sections (86); said lines (84) of spaced openings (36) dividing said first sheet (16) into a plurality of sections (86); and

a second sheet (18) releasably attached in facing engagement to said first sheet (16) and having a pattern (33) of continuous curvilinear openings (32) extending therethrough, said pattern (33) of continuous curvilinear openings (32) dividing said second sheet (18) into a corresponding plurality of sections (88); said pattern (33) of continuous curvilinear openings (32) of said second sheet (18) and said pattern (37) of spaced openings (36) of said first sheet (16) being in alignment with each other.

2. The product (80) as recited in claim 1, wherein each section (88) of said second sheet (18) includes an adhesive material (92) attached to an inward-facing surface (89).

3. The product (80) as recited in claim 2, wherein said adhesive material (92) releasably attaches each of said sections (88) of said second sheet (18) to said first sheet (16) and said adhesive material (92) remains attached to said inward-facing surface (89) upon removal of one of said sections (88) of said second sheet (18) from said first sheet (16) to enable attachment of said removed section (88) of said second sheet (18) to another surface.

4. The product (80) as recited in claim 1, wherein each section (86) of said first sheet (16) is detachable from a remainder of said first sheet (16) by tearing said first sheet (16) along said one or more lines (84) of said pattern (37) of spaced openings (36).

5. The product (80) as recited in claim 4, wherein aligned sections (86) and (88) of said first sheet (16) and said second sheet (18) are removable from a remainder of said first sheet (16) as a single unit.

6. The product (80) as recited in claim 1, wherein each of said sections (88) of said second sheet (18) are

detachable from a remainder of said sections (88) of said second sheet (18) and from said first sheet (16).

7. The product (80) as recited in claim 1, wherein each of said continuous curvilinear openings (32) extending through said second sheet (18) is serpentine-shaped.

8. The product (80) as recited in claim 1, wherein said continuous curvilinear openings (32) extending through said second sheet (18) form at least one quadrilateral (90).

9. A die sheet (10) for a die (12) for cutting a material (14) having first and second sheets (16) and (18) in facing relationship, said second sheet (18) being releasably attached to said first sheet (16), said die sheet (10) comprising:

a die sheet surface (20) having a die pattern (22) extending outwardly from said die sheet surface (20) to form a cutting line (24), said die pattern (22) being in the form of a plurality of quadrilaterals (90) sized to produce individually separable postage stamps, including their associated backings, having serpentine edges, said die pattern (22) having:

at least one slitting section (26) having at least one cutting edge (30) configured for providing a curvilinear, continuous opening (32) through said second sheet (18) of said material (14); and

a plurality of spaced perforating sections (28) extending outwardly from said slitting sections (26), each of said perforating sections (28) having at least one cutting edge (30) and being configured for extending at least partially through said first sheet (16) of said material (14), the cutting edges (30) of the perforating sections (28) and the cutting edges (30) of the slitting section (26) being in alignment with each other along the curvilinear opening (32) through said second sheet (18) so that when cutting the first sheet (16) the die pattern (22) contemporarily perforates the second sheet (18) along the curvilinear opening (32).

10. A method of constructing a die sheet (10) for cutting material (14), said method comprising the steps of:

(a) covering a portion of a die sheet surface (20) of said die sheet (10) with a plurality of dashed curvilinear lines of a first photo-resist material (52) to form a first pattern (54), each of said plurality of dashed curvilinear lines having a first

width (W_1);

(b) covering at least one continuous section (56) of said die sheet surface (20) with a plurality of continuous curvilinear lines of a second photo-resist material (57) to form a second pattern (58), each of said plurality of continuous lines of the second photo-resist material (57) having a second width (W_2), said second pattern (58) covering said first pattern (54) with the dashed lines being in alignment with the continuous lines and said second width (W_2) being greater than said first width (W_1);

(c) removing material (14) from sections (56) of said die sheet (10) not covered by said second pattern (58) by applying a chemical to said die sheet surface (20) of said die sheet (10);

(d) removing said second photo-resist material (57) from said die sheet (10) by applying a solvent to said die sheet surface (20), said first photo-resist material (52) being non-reactive with said solvent; and

(e) removing material (14) from sections of said die sheet (10) not covered by said first pattern (54) by applying a chemical to said die sheet surface (20) of said die sheet (10) to, in combination with step (c), form a plurality of cutting edges (31) each comprising a curvilinear body having a top edge (27) and (28) positioned at alternating distances above said die sheet (10).

11. The method as recited in claim 10, wherein in step (b) a plurality of continuous sections (56) of said die sheet surface (20) are covered by said second pattern (58) of said second photo-resist material (57).

12. The method as recited in claim 10, wherein in step (b) said second pattern (58) includes a plurality of reinforcing segments (60) of a third width (W_3), each reinforcing segment (60) being disposed proximal to an end (51) of each of said spaced sections (50) of said die sheet (10) covered by said first pattern (54), said third width (W_3) being greater than said second width (W_2).

13. A method of constructing a die sheet (10) for cutting material (14), said method comprising the steps of:

(a) covering a portion of a die sheet surface (20) of said die sheet (10) with a photo-resist material (57) to form a pattern (68) comprised of a plurality of curvilinear lines (69) each having a plurality of slitting segments (70) of a first width (W_1) and a plurality of perforating segments (72) of a second width (W_2), said plurality of slitting segments (70) and said plurality of perforating segments (72) being arranged in an alternating manner, said second width (W_2) being greater than said first width (W_1); and

(b) removing material (14) from said die sheet surface (20) of said die (12) by applying a chemical to said die sheet surface (20) to form a plurality of cutting edges (31) each comprising a curvilinear body each extending above said die sheet surface (20), said photo-resist material (57) being resistant to said chemical, said chemical completely undercutting portions of each curvilinear body along said plurality of slitting segments (70) to form a plurality of slitting sections (26), said chemical partially undercutting each curvilinear body along said plurality of perforating segments (72) to form a plurality of perforating sections (28), said plurality of perforating sections (28) having a greater height than said plurality of slitting sections (26).

14. The method as recited in claim 13, wherein in step (b) said chemical undercuts said plurality of perforating segments (72) a sufficient distance so that said plurality of perforating sections (28) include a single cutting edge (30).

15. The method as recited in claim 13, wherein in step (a) each of said plurality of perforating segments (72) extends from a side of said pattern (68) opposite a side of said pattern (68) from which another most proximal perforating segment (72) extends.

Patentansprüche

1. Papierprodukt (80) umfassend: Ein erstes Blatt (16) mit einem Muster (37) von zumindest zwei Linien (84) beabstandeter Aussparungen (36), die sich in Längs- und Querrichtungen hiervon zumindest teilweise in einer Distanz hindurch erstrecken, die ausreichend ist, dass das Blatt (16) leicht in einen oder mehrere Abschnitte (86) teilbar ist, wobei die besagten Linien (84) beabstandeter Aussparungen (36) das besagte erste Blatt (16) in eine Mehrzahl von Abschnitten (86) aufteilen; und ein zweites Blatt (18), welches lösbar in flächiger Anlage an dem ersten Blatt (16) angefügt ist und ein Muster (33) kontinuierlicher krummliniger Aussparungen (32) aufweist, die sich durch dieses hindurch erstrecken, wobei das Muster (33) kontinuierlicher krummliniger Aussparung (32) das zweite Blatt (18) in eine entsprechende Mehrzahl von Abschnitten (88) aufteilt; wobei das Muster (33) kontinuierlicher krummliniger Aussparung (32) des besagten zweiten Blattes (16) und das besagte Muster (37) beabstandeter Aussparungen (36) des besagten ersten Blattes (16) miteinander fluchten.

2. Produkt (80) nach Anspruch 1, wobei jeder Abschnitt (88) des besagten zweiten Blattes (18) ein

haftendes Material beinhaltet, das an einer nach innen gerichteten Oberfläche (89) angebracht ist.

3. Produkt (80) nach Anspruch 2, wobei das haftende Material (92) jedes der besagten Abschnitte (88) des besagten zweiten Blattes (18) lösbar an das erste Blatt (16) anfügt ist und wobei das haftende Material (92) an der nach innen gerichteten Oberfläche (89) bei Entfernung eines der besagten Abschnitte (88) des zweiten Blattes (18) vom ersten Blatt (16) angefügt verbleibt, um das Anfügen des entfernten Abschnittes (88) des zweiten Blattes (18) auf eine andere Oberfläche zu ermöglichen. 5 10
4. Produkt (80) nach Anspruch 1, wobei jeder Abschnitt (86) des ersten Blattes (16) von einem Rest des ersten Blattes (16) entfernbar ist, indem man das erste Blatt (16) entlang einer oder mehrerer Linien (84) des Musters (37) beabstandeter Aussparungen (36) durchreißt. 15 20
5. Produkt (80) nach Anspruch 4, wobei fluchtende Abschnitte (86) und (88) des ersten Blattes (16) und des zweiten Blattes (18) von einem Rest des ersten Blattes (16) als eine einzelne Einheit entfernbar sind. 25
6. Produkt (80) nach Anspruch 1, wobei jeder der Abschnitte (88) des zweiten Blattes (18) von einem Rest der Abschnitte (88) des zweiten Blattes (18) und von dem ersten Blatt (16) lösbar sind. 30
7. Produkt (80) nach Anspruch 1, wobei jede der kontinuierlichen krummlinigen Aussparungen (32), die sich durch das zweite Blatt (18) erstrecken, schlangelinienförmig ist. 35
8. Produkt (80) nach Anspruch 1, wobei die kontinuierlichen krummlinigen Aussparungen (32), die sich durch das zweite Blatt (18) erstrecken, zumindest ein Trapezoid (90) bilden. 40
9. Stempelbogen (10) für einen Stempel (12) zum Schneiden eines Materials (14) mit ersten und zweiten Blättern (16) und (18) in flächiger gegenseitiger Anlage, wobei das zweite Blatt (18) lösbar am ersten Blatt (16) angefügt ist, und wobei der Stempelbogen (10) umfasst: 45
 - eine Stempelbogenoberfläche (20) mit einem Stempelmuster (22), das sich von der Stempelbogenoberfläche (20) nach außen erstreckt, um eine Schneidlinie (24) zu bilden, wobei das Stempelmuster (22) in Form einer Mehrzahl von Trapezoiden (90) ausgebildet ist mit einer Größe, um einzeln lösbare Briefmarken einschließlich ihrer verbundenen Trägerschicht herzustellen mit schlangelinienförmigen Kan-

ten, wobei das Stempelmuster (22) aufweist:

- zumindest einen Schlitzabschnitt (26) mit zumindest einer Schneidkante (30), die ausgebildet ist, um eine krummlinige kontinuierliche Aussparung (32) durch das zweite Blatt (18) des besagten Materials (14) zur Verfügung zu stellen; und
 - eine Mehrzahl beabstandeter Perforationsabschnitte (28), die sich nach außen von den Schlitzabschnitten (26) erstrecken, wobei jeder der Perforationsabschnitte (28) zumindest eine Schneidkante (30) aufweist und dazu konfiguriert ist, sich zumindest teilweise durch das erste Blatt (16) des besagten Materials (14) zu erstrecken, wobei die Schneidkanten (30) der Perforationsabschnitte (28) und die Schneidkanten (30) des Schlitzabschnittes (26) miteinander entlang der krummlinigen Aussparung (32) durch das zweite Blatt (18) fluchten, so dass beim Schneiden des ersten Blattes (16) das Stempelmuster (22) gleichzeitig das zweite Blatt (18) entlang der krummlinigen Aussparung (32) perforiert.
10. Verfahren zum Erstellen eines Stempelbogens (10) zum Schneiden von Material (14), wobei das Verfahren die folgenden Verfahrensschritte aufweist:
 - (a) Bedecken eines Bereichs einer ersten Stempelbogenoberfläche (20) des Stempelbogens (10) mit einer Mehrzahl gestrichelter gekrümmter Linien eines ersten Photowiderstandsmaterials (52), um ein erstes Muster (54) zu bilden, wobei jede der Mehrzahl gestrichelter gekrümmter Linien eine erste Breite (W_1) aufweist;
 - (b) Bedecken zumindest eines kontinuierlichen Abschnittes (56) der ersten Stempelbogenoberfläche (20) mit einer Mehrzahl kontinuierlicher gekrümmter Linien eines zweiten Photowiderstandsmaterials (57), um ein zweites Muster (58) zu bilden, wobei jede der besagten Mehrzahl kontinuierlicher Linien des zweiten Photowiderstandsmaterials (57) eine zweite Breite (W_2) aufweist, wobei das zweite Muster (58), das das erste Muster (54) mit den gestrichelten Linien bedeckt, fluchtend mit den kontinuierlichen Linien angeordnet ist und wobei die genannte zweite Breite (W_2) größer als die genannte erste Breite (W_1) ist;
 - (c) Entfernen desjenigen Materials (14) von den Abschnitten (56) des Stempelbogens (10), das nicht durch das zweite Muster (58) bedeckt ist, durch Auftragen einer Chemikalie auf die Stempelbogenoberfläche (20) des Stempelbo-

- gens (10);
 (d) Entfernen des zweiten Photowiderstandsmaterials (57) von dem Stempelbogen (10) durch Auftragen einer Lösung auf die Stempelbogenoberfläche (20), wobei das Photowiderstandsmaterial (52) nicht mit der Lösung reagierend ausgebildet ist; und
 (e) Entfernen desjenigen Materials (14) von Abschnitten des Stempelbogens (10), das nicht durch das erste Muster (54) bedeckt ist, durch Auftragen einer Chemikalie auf die Stempelbogenoberfläche (20) des Stempelbogens (10), um in Kombination mit Verfahrensschritt (c) eine Mehrzahl von Schneidkanten (31) zu bilden, wobei jede einen krummlinigen Aufbau besitzt mit einer oberen Kante (27) und (28), die in abwechselnden Abständen von dem Stempelbogen (10) positioniert sind.
11. Verfahren nach Anspruch 10, wobei im Verfahrensschritt (b) eine Mehrzahl kontinuierlicher Abschnitte (56) der Stempelbogenoberfläche (20) durch das zweite Muster (58) des zweiten Photowiderstandsmaterials (57) bedeckt sind.
12. Verfahren nach Anspruch 10, wobei im Verfahrensschritt (b) das zweite Muster (58) eine Mehrzahl von Verstärkungssegmenten (60) mit einer dritten Breite (W_3) beinhaltet, wobei jedes Verstärkungssegment (60) in der Nähe eines Endes (51) von jedem der besagten beabstandeten Abschnitte (50) des Stempelbogens (10) angeordnet ist, der durch das erste Muster (54) bedeckt ist, wobei die dritte Breite (W_3) größer als die zweite Breite (W_2) ist.
13. Verfahren zur Erstellung eines Stempelbogens (10) zum Schneiden von Material (14), wobei das Verfahren die folgenden Verfahrensschritte umfasst:
- (a) Bedecken eines Bereiches einer Stempelbogenoberfläche (20) des Stempelbogens (10) mit einem Photowiderstandsmaterial (57), um ein Muster (68) zu bilden, das aus einer Mehrzahl von gekrümmten Linien (69) besteht, die jeweils eine Mehrzahl von geschlitzten Segmenten (70) einer ersten Breite (W_1) und eine Mehrzahl von Perforationssegmenten (72) einer zweiten Breite (W_2) aufweisen, wobei die Mehrzahl der geschlitzten Segmente (70) und die Mehrzahl der Perforationssegmente (72) in abwechselnder Art und Weise angeordnet sind, wobei die zweite Breite (W_2) größer als die erste Breite (W_1) ist; und
 (b) Entfernen des Materials (14) von der Stempelbogenoberfläche (20) des Stempels (12) durch Auftragen einer Chemikalie auf die Stempelbogenoberfläche (20), um eine Mehrzahl von Schneidkanten (31) zu bilden, wobei jede

einen krummlinigen Aufbau aufweist, der sich oberhalb der Bogenoberfläche (20) erstreckt, wobei das Photowiderstandsmaterial (57) widerstandsfähig gegenüber der Chemikalie ist, wobei die Chemikalie vollständig Bereiche jedes krummlinigen Aufbaus entlang der Mehrzahl von geschlitzten Segmenten (70) hinter-schneidet, um eine Mehrzahl von geschlitzten Abschnitten (26) zu bilden, wobei die Chemikalie teilweise jeden krummlinigen Aufbau entlang der Mehrzahl von Perforationssegmenten (72) hinter-schneidet, um eine Mehrzahl von Perforationsabschnitten (28) zu bilden, und wobei die Mehrzahl der Perforationssegmente (28) eine größere Höhe als die Mehrzahl der geschlitzten Abschnitte (26) aufweist.

14. Verfahren nach Anspruch 13, wobei im Verfahrensschritt (b) die Chemikalie die Mehrzahl der Perforationssegmente (72) in ausreichendem Abstand hinterscheidet, so dass die Mehrzahl der Perforationsabschnitte (28) eine einzige Schneidkante (30) beinhalten.

15. Verfahren nach Anspruch 13, wobei im Verfahrensschritt (a) jedes der Mehrzahl der Perforationssegmente (72) sich von einer Seite des Musters (68) erstreckt, die gegenüberliegend von einer Seite des Musters (68) ist, von der sich ein anderes nächstliegendes Perforationssegment (72) erstreckt.

Revendications

1. Produit papetier (80) composé de :

une première feuille (16) présentant un motif (37) d'au moins deux lignes (84) d'ouvertures espacées (36) s'étendant dans les directions longitudinale et transversale de celui-ci partiellement au moins à travers celui-ci sur une distance suffisante pour permettre de séparer facilement ladite feuille (16) en une ou plusieurs sections (86), lesdites lignes (84) d'ouvertures espacées (36) divisant ladite première feuille (16) en une pluralité de sections (86) ; et
 une deuxième feuille (18) attachée de façon libérable en prise face-à-face avec ladite première feuille (16) et présentant un motif (33) d'ouvertures curvilignes continues (32) s'étendant à travers celle-ci, ledit motif (33) d'ouvertures curvilignes continues (32) divisant ladite deuxième feuille (18) en une pluralité correspondante de sections (88) ; ledit motif (33) d'ouvertures curvilignes continues (32) de ladite deuxième feuille (16) et ledit motif (37) d'ouvertures espacées (36) de ladite première feuille (16) étant alignés l'un avec l'autre.

2. Produit (80) selon la revendication 1, dans lequel chaque section (88) de ladite deuxième feuille (18) comporte un matériau adhésif (92) fixé à une surface dirigée vers l'intérieur (89).

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3. Produit (80) selon la revendication 2, dans lequel ledit matériau adhésif (92) fixe de façon libérable -chacune desdites sections (88) de ladite deuxième feuille (18) à ladite première feuille (16) et ledit matériau adhésif (92) reste attaché à ladite surface dirigée vers l'intérieur (89) sur enlèvement de l'une desdites sections (88) de ladite deuxième feuille (18) de ladite première feuille (16) pour permettre la fixation de ladite section enlevée (88) de ladite deuxième feuille (18) à une autre surface.

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4. Produit (80) selon la revendication 1, dans lequel chaque section (86) de ladite première feuille (16) est détachable du reste de ladite première feuille (16) en déchirant ladite première feuille (16) le long de ladite une ou plusieurs lignes (84) dudit motif (37) d'ouvertures espacées (36).

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5. Produit (80) selon la revendication 4, dans lequel les sections alignées (86) et (88) de ladite première feuille (16) et de ladite deuxième feuille (18) peuvent être enlevées du reste de ladite première feuille (16) en un seul morceau.

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6. Produit (80) selon la revendication 1, dans lequel chacune desdites sections (88) de ladite deuxième feuille (18) est détachable du reste desdites sections (88) de ladite deuxième feuille (18) et de ladite première feuille (16).

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7. Produit (80) selon la revendication 1, dans lequel chacune desdites ouvertures curvilignes continues (32) s'étendant à travers ladite deuxième feuille (18) est de forme sinueuse.

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8. Produit (80) selon la revendication 1, dans lequel lesdites ouvertures curvilignes continues (32) s'étendant à travers ladite deuxième feuille (18) forment au moins un quadrilatère (90).

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9. Feuille emporte-pièce (10) pour un emporte-pièce (12) destiné à couper un matériau (14) comportant des première et deuxième feuilles (16) et (18) en relation face-à-face, ladite deuxième feuille (18) étant attachée de façon libérable à ladite première feuille (16), ladite feuille emporte-pièce (10) comprenant :

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une surface de feuille emporte-pièce (20) présentant un motif d'emporte-pièce (22) s'étendant vers l'extérieur à partir de ladite surface de feuille emporte-pièce (20) pour former une ligne de coupe (24), ledit motif d'emporte-pièce

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(22) étant sous la forme d'une pluralité de quadrilatères (90) dimensionnés pour produire des timbres-poste) séparables individuellement, comprenant leurs papiers dorsaux associés, présentant des bords sinueux, ledit motif d'emporte-pièce (22) comportant :

une section de refendage (26) présentant un bord coupant au moins (30) configuré pour procurer une ouverture curviligne continue (32) à travers ladite deuxième feuille (18) dudit matériau (14) ; et une pluralité de sections de perforation espacées (28) s'étendant vers l'extérieur à partir desdites sections de refendage (26), chacune desdites sections de perforation (28) présentant un bord coupant au moins (30) et étant configurée pour s'étendre au moins partiellement à travers ladite première feuille (16) dudit matériau (14), les bords coupants (30) des sections de perforation (28) et les bords coupants (30) de la section de refendage (26) étant alignés l'un avec l'autre le long de l'ouverture curviligne (32) à travers ladite deuxième feuille (18) de façon qu'en coupant la première feuille (16), le motif de coupe (22) perfore en même temps la deuxième feuille (18) le long de l'ouverture curviligne (32).

10. Procédé de construction d'une feuille emporte-pièce (10) destinée à couper un matériau (14), ledit procédé comprenant les étapes consistant à :

(a) recouvrir une partie d'une surface de feuille emporte-pièce (20) de ladite feuille emporte-pièce (10) d'une pluralité de lignes curvilignes en trait tireté d'un premier matériau photosensible (52) pour former un premier motif (54), chacune parmi ladite pluralité de lignes curvilignes en trait tireté présentant une première largeur

(b) recouvrir une section continue (56) au moins de ladite surface de feuille emporte-pièce (20) d'une pluralité de lignes curvilignes continues d'un deuxième photosensible (57) pour former un deuxième motif (58), chacune parmi ladite pluralité de lignes curvilignes continues du deuxième matériau photosensible (57) présentant une deuxième largeur (W_2), ledit deuxième motif (58) recouvrant ledit premier motif (54), les lignes en trait tireté étant alignées avec les lignes continues et ladite deuxième largeur (W_2) étant supérieure à ladite première largeur (W_1) ;

(c) enlever le matériau (14) des sections (56) de ladite feuille emporte-pièce (10) non recouvertes par ledit deuxième motif (58) en appli-

quant un produit chimique sur ladite surface de feuille emporte-pièce (20) de ladite feuille emporte-pièce (10) ;

(d) enlever ledit deuxième matériau photosensible (57) de ladite feuille emporte-pièce (10) en appliquant un solvant sur ladite surface de feuille emporte-pièce (20), ledit premier matériau photosensible (52) ne réagissant pas avec ledit solvant ; et

(e) enlever le matériau (14) des sections de ladite feuille emporte-pièce (10) non recouvertes par ledit premier motif (54) en appliquant un produit chimique sur ladite surface de feuille emporte-pièce (20) de ladite feuille emporte-pièce (10) pour, en combinaison avec l'étape (c), former une pluralité de bords coupants (31) comprenant chacun un corps curviligne présentant un bord supérieur (27) et (28) positionnés à des distances alternées au-dessus de ladite feuille emporte-pièce (10).

11. Procédé selon la revendication 10, dans lequel dans l'étape (b), une pluralité de sections continues (56) de ladite surface de feuille emporte-pièce (20) est recouverte par ledit deuxième motif (58) dudit deuxième matériau photosensible (57).

12. Procédé selon la revendication 10, dans lequel dans l'étape (b), ledit deuxième motif (58) comprend une pluralité de segments de renforcement (60) d'une troisième largeur (W_3), chaque segment de renforcement (60) étant disposé à proximité d'une extrémité (51) de chacune desdites sections espacées (50) de ladite feuille emporte-pièce (10) recouverte par ledit premier motif (54), ladite troisième largeur (W_3) étant supérieure à ladite deuxième largeur (W_2).

13. Procédé de construction d'une feuille emporte-pièce (10) destinée à couper un matériau (14), ledit procédé comprenant les étapes consistant à :

(a) recouvrir une partie d'une surface de feuille emporte-pièce (20) de ladite feuille emporte-pièce (10) d'un matériau photosensible (57) pour former un motif (68) composé d'une pluralité de lignes curvilignes (69) comportant chacune une pluralité de segments de refendage (70) d'une première largeur (W_1) et une pluralité de segments de perforation (72) d'une deuxième largeur (W_2), ladite pluralité de segments de refendage (70) et ladite pluralité de segments de perforation (72) étant disposées d'une manière alternée, ladite deuxième largeur (W_2) étant supérieure à ladite première largeur (W_1) ; et

(b) enlever le matériau (14) de ladite surface de feuille emporte-pièce (20) dudit emporte-pièce

(12) en appliquant un produit chimique sur ladite surface de feuille emporte-pièce (20) pour former une pluralité de bords coupants (31) comprenant chacun un corps curviligne, s'étendant chacun au-dessus de ladite surface de feuille emporte-pièce (20), ledit matériau photosensible (57) étant résistant audit produit chimique, ledit produit chimique entaillant complètement les parties de chaque corps curviligne le long de ladite pluralité de segments de refendage (70) pour former une pluralité de sections de refendage (26), ledit produit chimique entaillant partiellement chaque corps curviligne le long de ladite pluralité de segments de perforation (72) pour former une pluralité de sections de perforation (28), ladite pluralité de sections de perforation (28) présentant une hauteur supérieure à celle de ladite pluralité de sections de refendage (26).

14. Procédé selon la revendication 13, dans lequel dans l'étape (b) ledit produit chimique entaille ladite pluralité de segments de perforation (72) sur une distance suffisante pour que ladite pluralité de sections de perforation (28) comprenne un bord coupant unique (30).

15. Procédé selon la revendication 13, dans lequel dans l'étape (a) chacun parmi ladite pluralité de segments de perforation (72) s'étend à partir d'un côté dudit motif (68) opposé à un côté dudit motif (68) à partir duquel s'étend un autre segment de perforation plus proche (72).

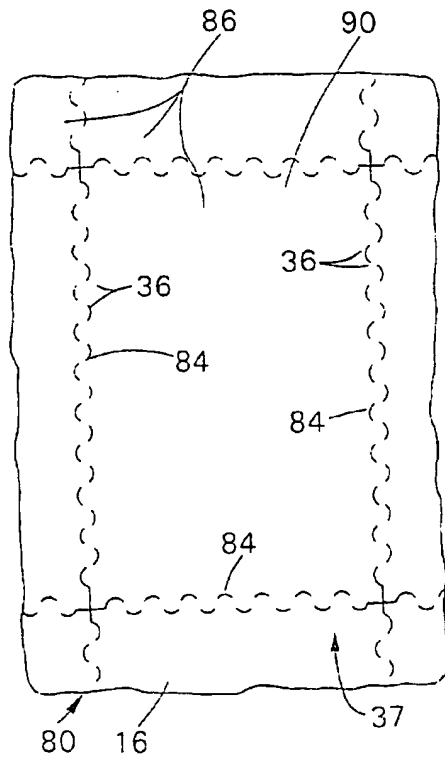


Fig. 1

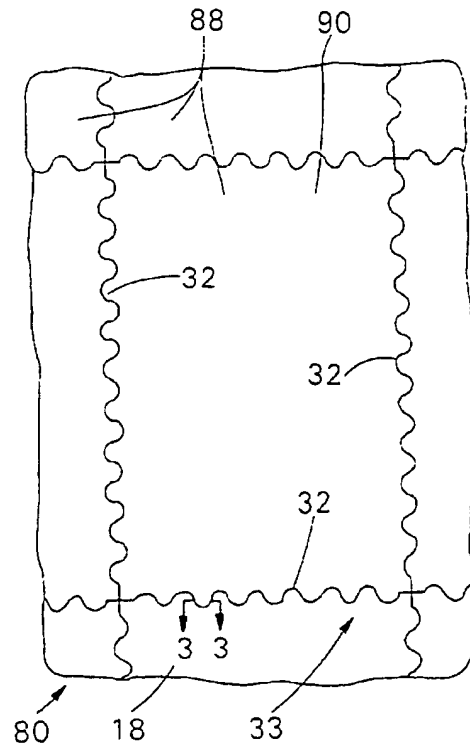


Fig. 2

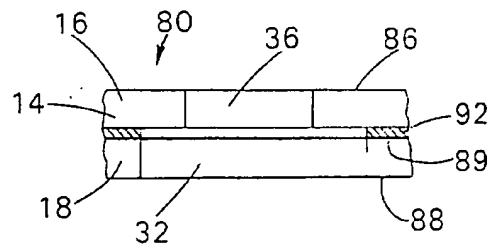


Fig. 3

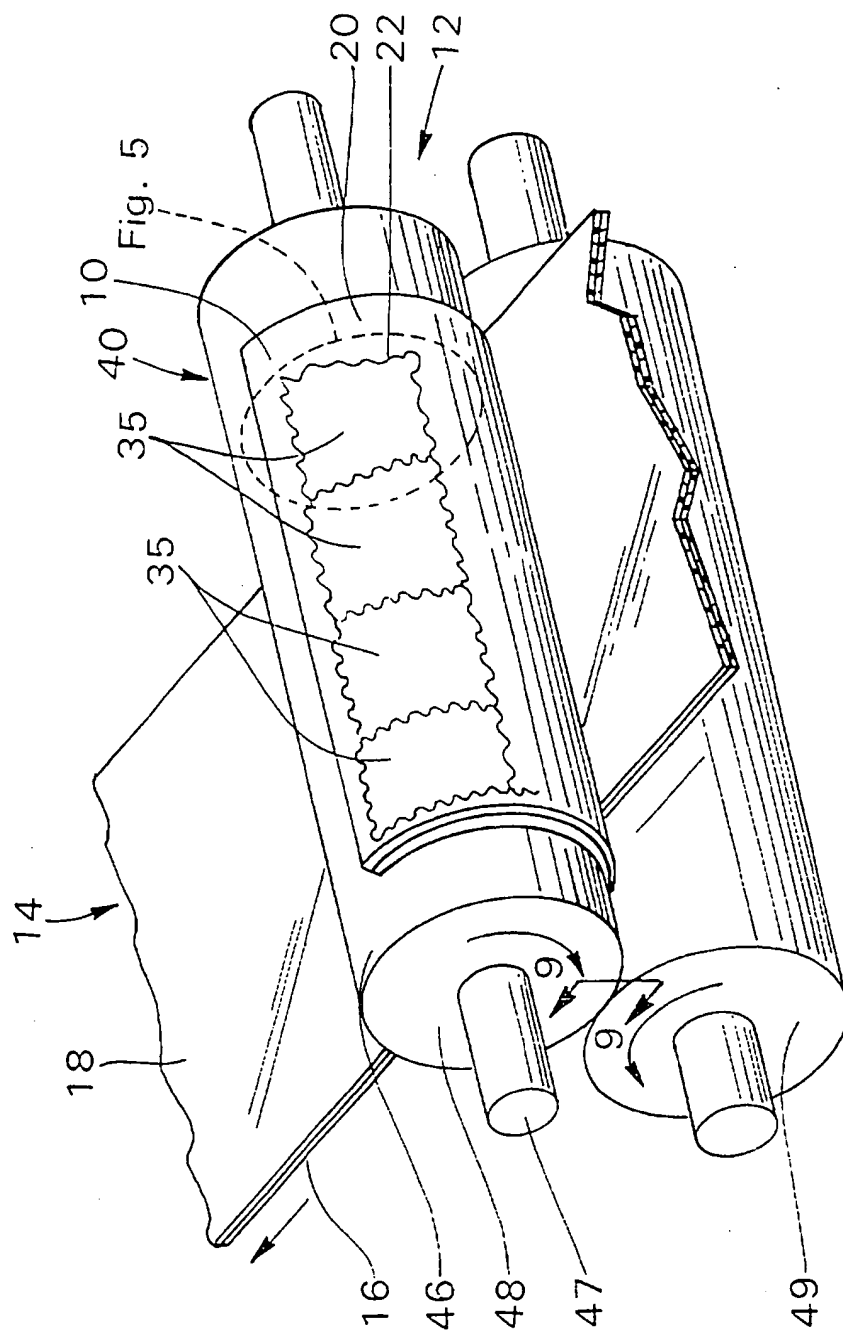


Fig. 4

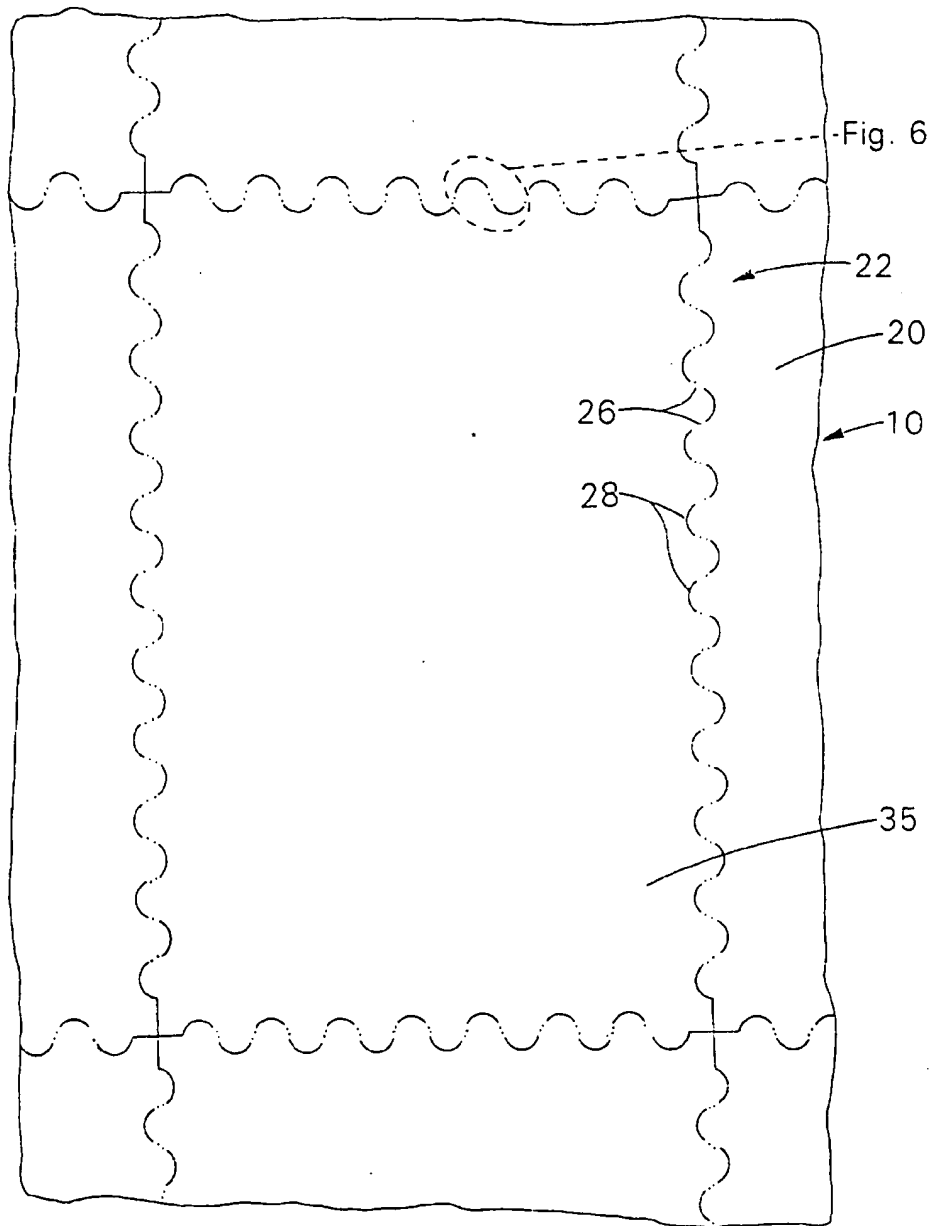
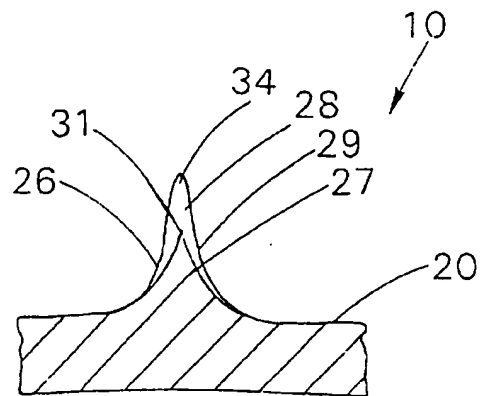
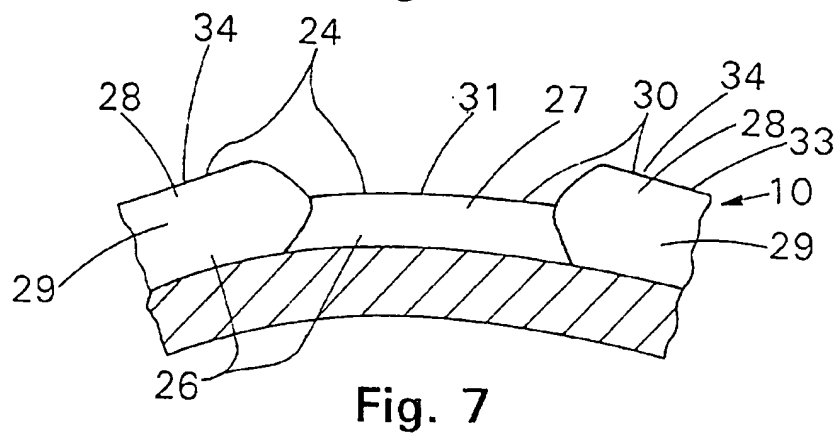
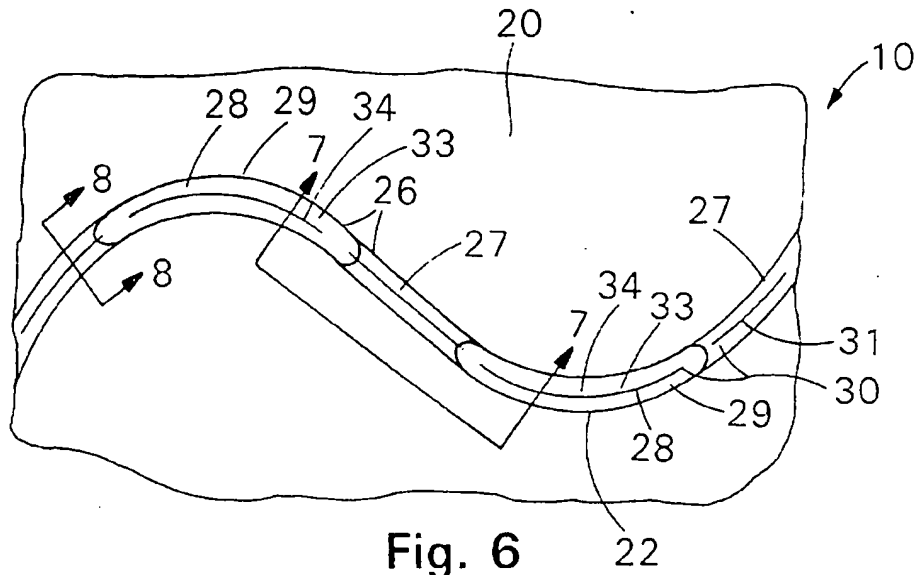


Fig. 5



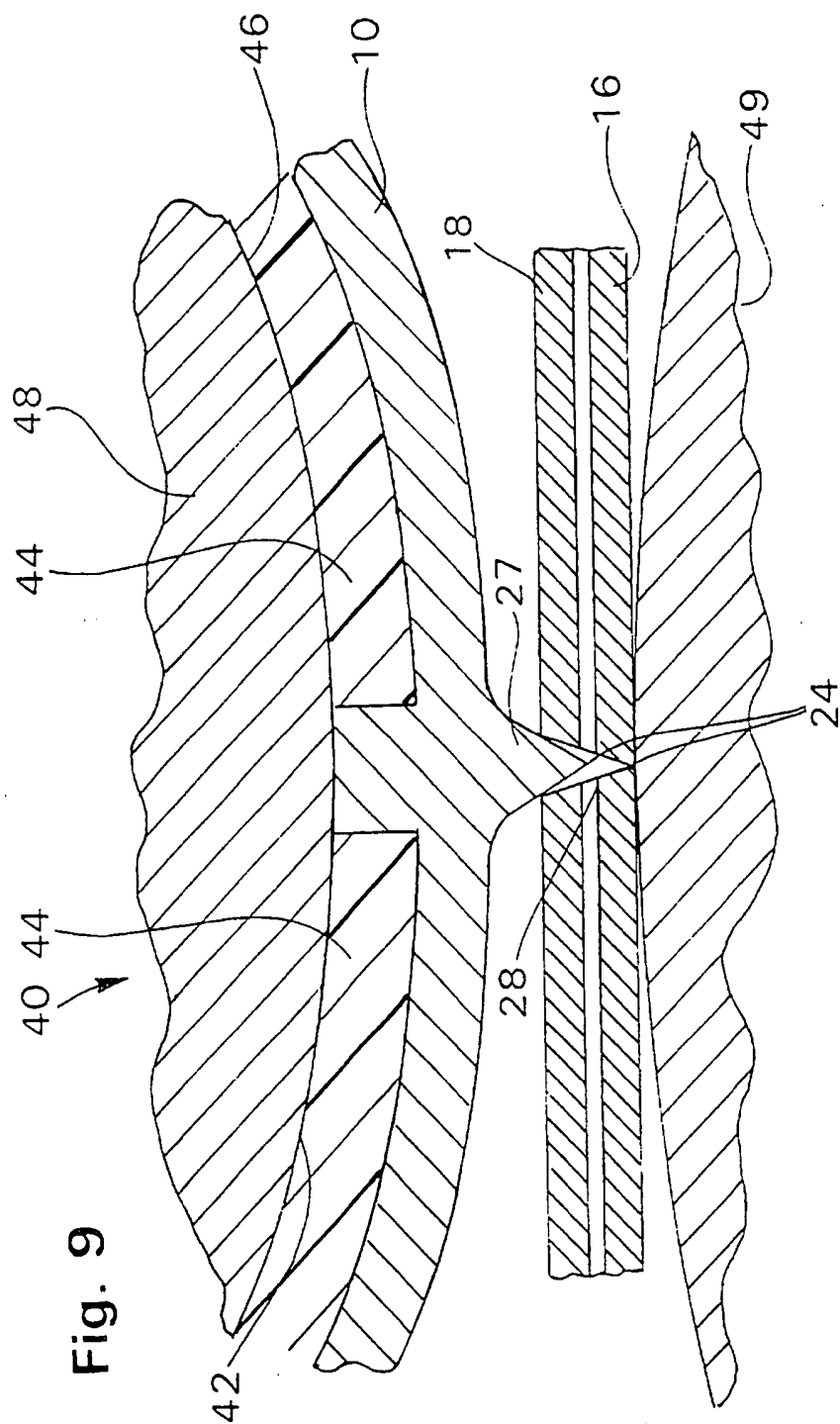


Fig. 9

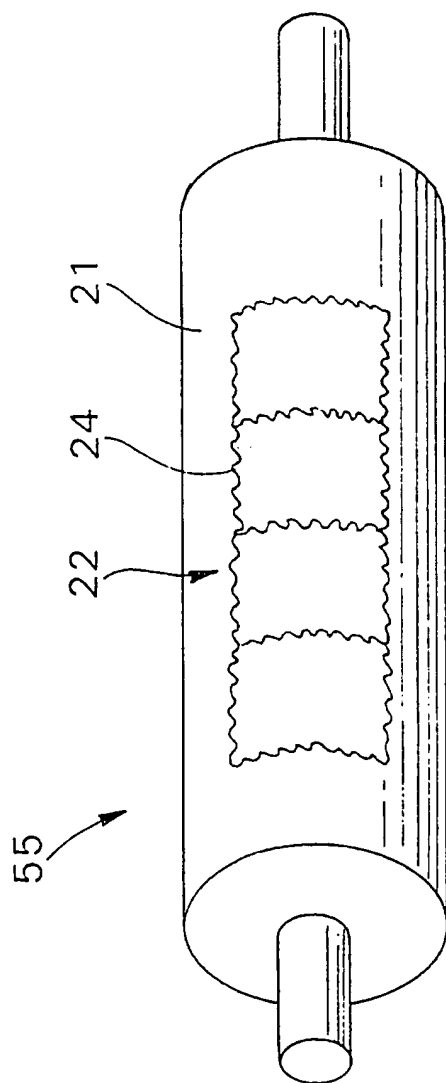


Fig. 10

Fig. 11

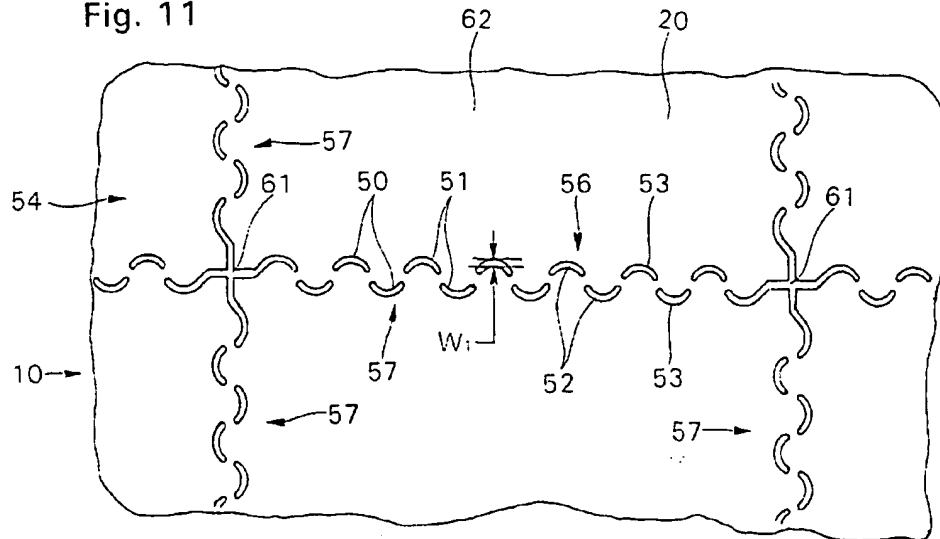
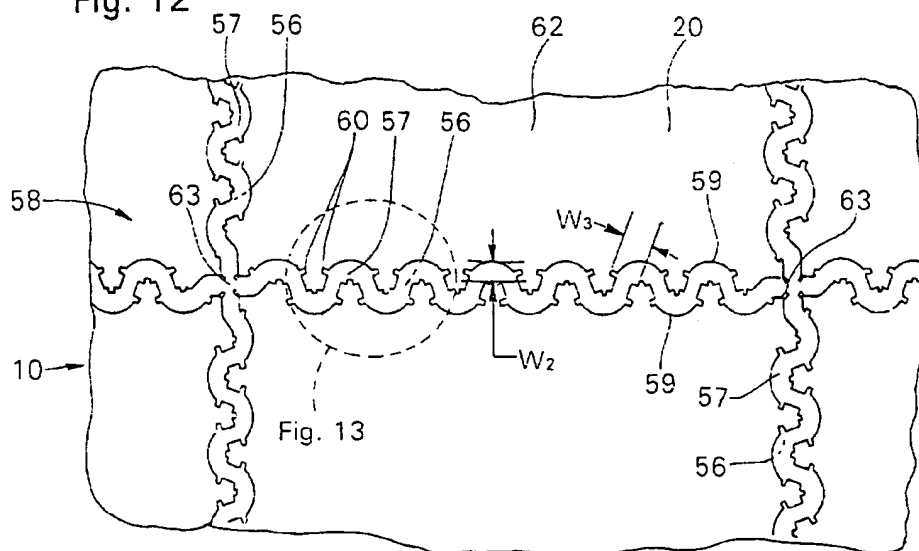


Fig. 12



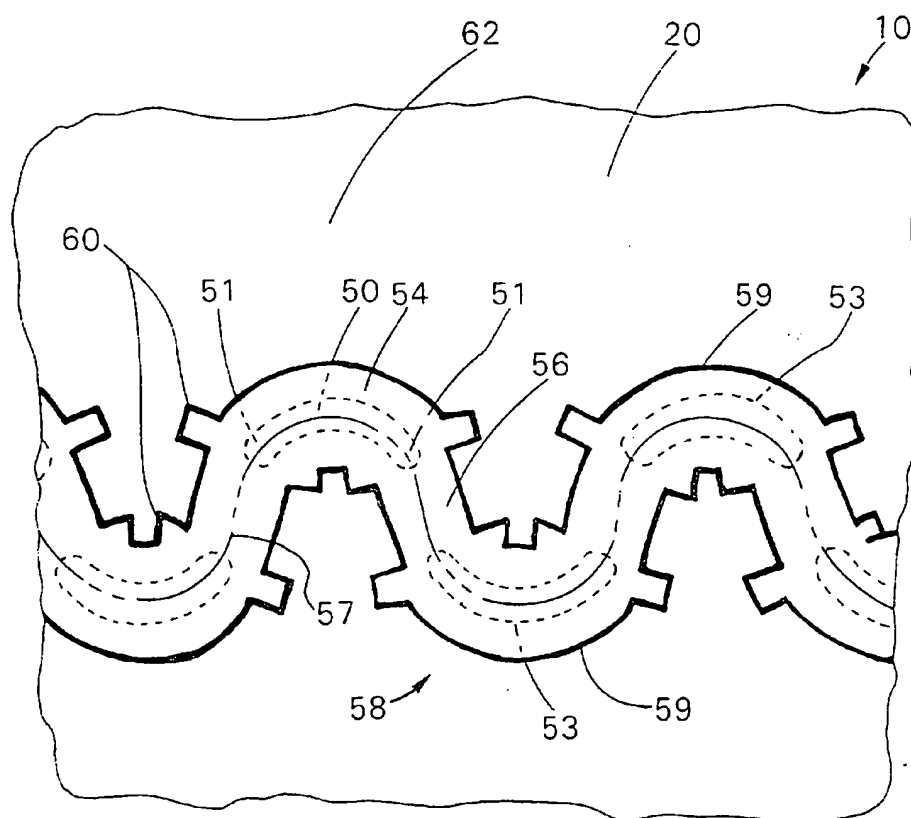


Fig. 13

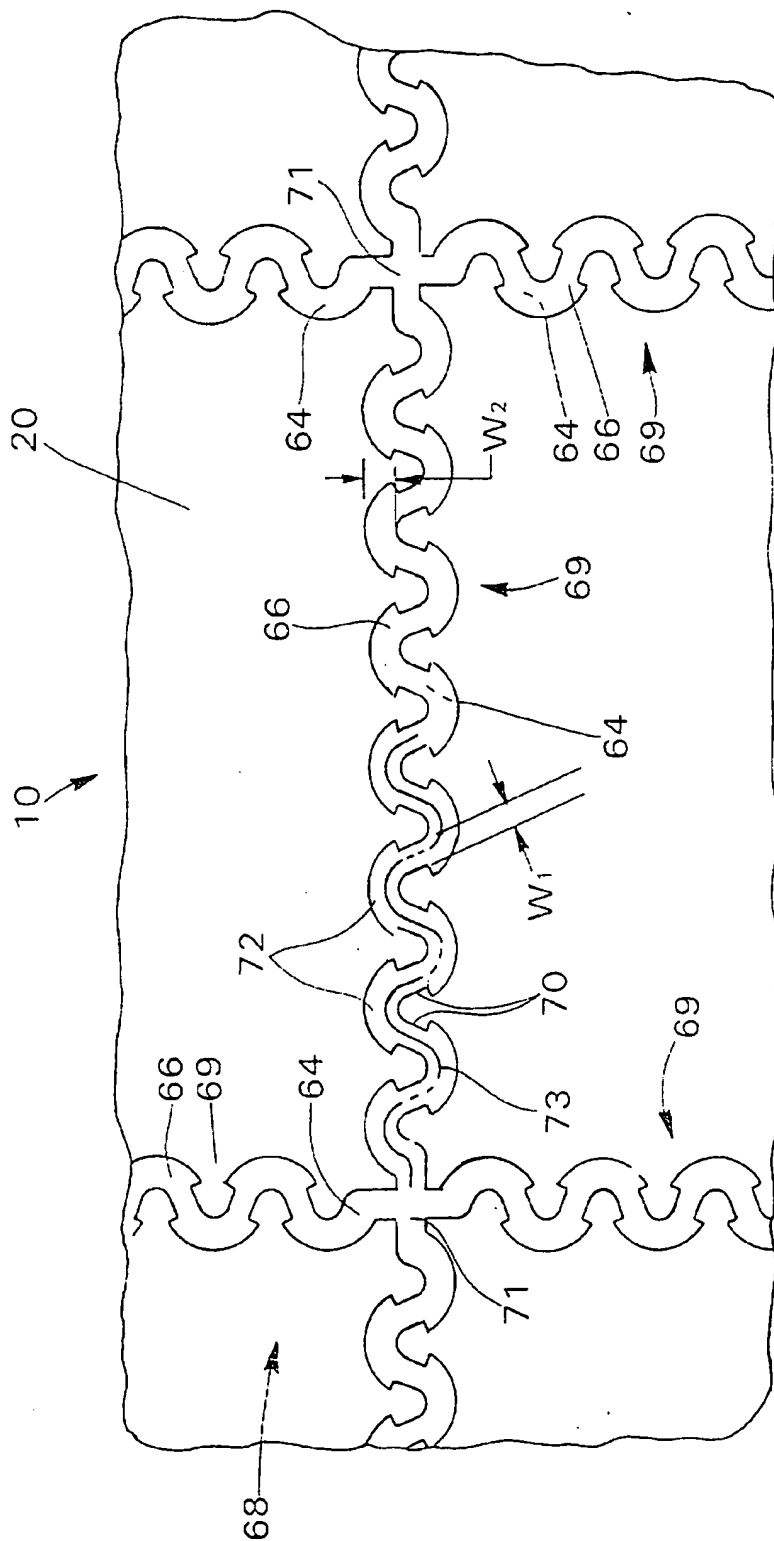
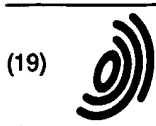


Fig. 14



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(30) Priority: 12.11.1996 US 747950

(71) Applicant: **Xynatech, Inc.**
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(54) **Perforating and slitting die sheet, methods of constructing same and paper product produced therefrom**

(57) A paper product has a first sheet with a pattern of spaced openings permitting separation into sections and a second sheet releasably attached to the first sheet with a pattern of continuous curvilinear openings dividing the sheet into sections and being aligned with the openings of the first sheet. A die sheet for a die for cutting material includes a die sheet surface with a die pattern extending outwardly from the die sheet surface. The die pattern has slitting sections providing curvilinear, continuous openings through a second sheet of the material and spaced perforating sections extending above the slitting sections providing a pattern of spaced openings in the first sheet adjacent to the openings through the second sheet. A first method of constructing a die sheet includes covering a die surface with a first, spaced pattern of a first photo-resist material and then covering the first pattern with a second, continuous pattern of a second photo-resist material. A chemical removes material from sections not covered by the second pattern and the second pattern is then removed. A chemical removes material from die surface sections not covered by the first pattern. A second method of constructing a die sheet includes covering sections of a die surface with a pattern of photo-resist material having alternating slitting segments and wider perforating segments. A chemical removes material from uncovered sections and completely undercuts the slitting segments to form slitting sections and undercuts the perforating segments to form higher extending perforating sections.

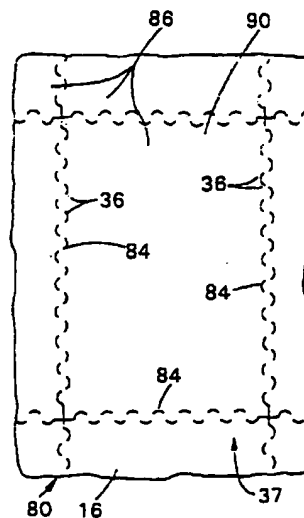


Fig. 1

EP 0 841 649 A3

EUROPEAN SEARCH REPORT

Application Number
EP 97 11 9595

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 11 February 1999	Examiner Vaglianti, G
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 11 9595

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.8)
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			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 11 February 1999	Examiner Vaglianti, G
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			

EPO FORM 1503 03.82 (P04C01)



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Application Number

EP 97 11 9595

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- ☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:



European Patent
Office

LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 97 11 9595

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims: 1-8

adhesive label

2. Claims: 9-14

cutting die

3. Claims: 15-20

method of manufacturing a cutting die

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 97 11 9595

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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11-02-1999

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82